

My SUPER Experience at the University of Stuttgart 2022  
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Major: Chemical Engineering  
Project: Determination of Thermodynamic Properties  
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I hereby agree to my report being published on the websites of the Christian Bürkert  
Stiftung and the University of Stuttgart.

## **Experience with the Program:**

The SUPER program was not my first time being away from home for an extended period. That being said, studying abroad in a foreign country for two months straight was a new experience for me. While this experience certainly was worth it, there were obstacles that I encountered. There were times that I felt homesick, lost, or lonely, but the reason I got through that was because of the other students in the program with me. The memories we formed from our time together will never be forgotten.

One of my fondest memories with the rest of the SUPER Program was when we decided to take a day trip to Heidelberg, Germany. Heidelberg is a smaller sized town that is half way between Stuttgart and Frankfurt. Because Heidelberg is so close, it only took an hour train ride to get there which made it the perfect destination for a day trip. We arrived in Heidelberg around 9:00 am and got the chance to walk around the beautiful city. Afterwards we walked to the top of a mountain peak near the city, where we got an amazing view of the city.



After grabbing lunch at a restaurant at the top of the city, we slowly started to walk down the mountain. On the way down the mountain, we stopped and walked around Schloss Heidelberg, the castle that resided half way around the mountain top. In the castle, we got to see the interior and get an understanding of the castle's history. Afterwards, we walked around the city of Heidelberg where some of us went shopping and some of us simply walked around. In the end, everyone enjoying their time in Heidelberg greatly. Definitely one of our fondest memories as a program.



Throughout the two months I spent in Stuttgart, we continued to amass new adventures and memorable moments. Whether that took place in Stuttgart or in another city, there was always something to do. I can safely say that this program made my experience abroad significantly more enjoyable.

### **The Institute of Thermodynamics and Thermal Process Engineering:**

Despite being the only undergraduate student and the only student from my program in this institute, I always felt welcomed within my institute. Unfortunately, due to COVID related reasons, I started my time at the institute a week late. That did not prevent me from diving right into my research. With the help of my supervisor, Timm Esper, I was able to familiarize myself with the lab equipment while also understanding my overall objectives. The institute bases all of their data off of an Equation of State, discovered by a professor of the institute. This equation can tell us chemical properties of pure substances and mixed solutions and is very useful in determining the nature of species as it can tell us everything. It has many applications to outside clients; therefore, the institute strives to understand the chemical and thermodynamic nature of everything. My goal was to determine certain properties that would back the research of my supervisor.



To conduct my research, I would utilize various lab equipment throughout the institute to find specific properties of provided chemical mixtures. The properties that I sought to determine were the boiling points and the viscosities of these mixtures. These properties can tell us the most about the nature of a mixture. The image on the left gives us a preview of an ebulliometer, an apparatus that can heat a mixture to its boiling point and hold equilibrium. From there, the temperature and the pressure of the solution can be recorded using a computer application. The image in the middle shows us an LS Spectrometer, a high intensity laser that is used to calculate the viscosity of a chemical mixture. After careful preparation and filtration of the solution, the laser is pointed at the solution to detect the scattering of light. The results are recorded on a computer application hooked up to the apparatus.

In addition to using these devices to determine these thermodynamic properties, there were other methods of preparing solutions, determining the composition of mixtures, and testing the accuracy of our findings. As far as determining the composition of the mixtures I was testing, I used a gas chromatograph which can be seen in the right image. When it came to determining the accuracy of my results, I utilized scripts from Jupyter Lab and MATLAB which are in python and C++ respectively. These scripts were either provided to me or I had to type my own script. The institute provided me the chance to utilize the entirety their labs to conduct my research.



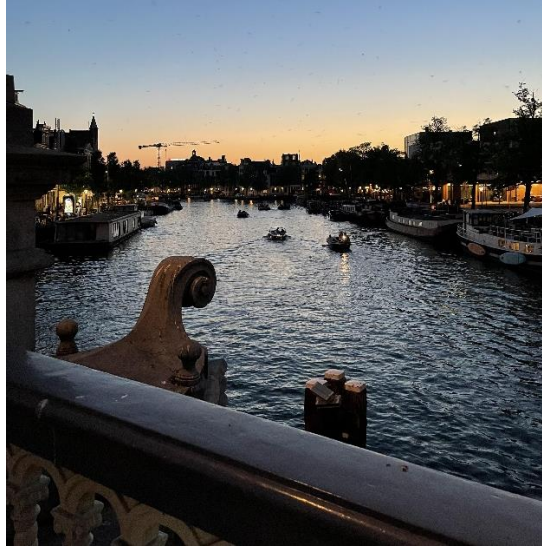
### **Traveling throughout Europe:**



Outside of Stuttgart, I got the chance to visit various cities throughout Germany. Whether it was to visit my family or for a simple day trip, there was always fun ways to spend the time in other cities. Outside of going to Heidelberg, my favorite cities that I visited were Cologne and Munich. Within both cities I got the chance to visit their famous cathedrals which can be seen in the images above. When I was in Cologne, I also got the chance to visit the world famous chocolate factory. My trip to Munich was amazing because I got to visit my family who was vacationing in Europe for the week. While in Munich for the weekend, we walked around the city and visited the famous Hofbräuhaus. I had a wonderful time visiting these cities and traveling throughout Germany.

### **Traveling outside Germany:**

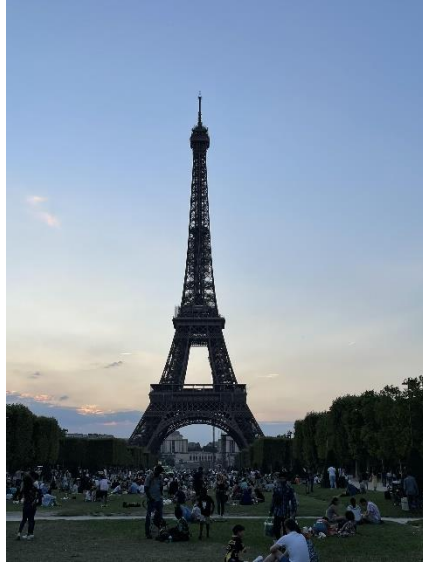
The blessing of this program is that given that you take the time to carefully communicate your schedule with your advisor, there is plenty of time to travel. Not only did I get the chance to travel within Germany, but I also left the country on three separate occasions.



The first destination I got the chance to visit was Amsterdam in the Netherlands. Visiting this city has been on my bucket list for years and I am glad I finally got to fulfill this wish. In my opinion, there are a lot of tourist attractions for everyone in Amsterdam, but it also is a great city for walking around. My favorite part of coming here was seeing the diverse architecture and the various canals throughout the city.



While not my first visit to London, my weekend here was definitely one of my highlights from my time in Europe. I got the chance to revisit for the first time in 8 years and see friends from school. London is one of my favorite cities due to its size and diverse culture. From visiting Big Ben to walking around Buckingham Palace and Hyde Park, I truly made the best of the weekend I was here. My favorite moment was getting to see Big Ben because last time I was in London it was under heavy construction.



The final trip I went on was to Paris and it was with with one of the other students in the program. For both of us, it was our first time in Paris and we both loved the city. It is a massive city that is hard to completely see in one weekend. The highlights of our stay included seeing the Eiffel Tower, visiting the Louvre, and viewing the Arc the Triomphe. Additionally, we got to see the beautiful architecture, canals dispersed across the city, and a great view of the city from Sacre Coeur. My favorite moment from this trip was going to the top of the Eiffel Tower at night and getting an amazing view of the city.

### **Tips for Future SUPER Participants:**

- Try to learn some basic German before your arrival and during your time here. While knowing German is not a requirement, knowing a little helps a great amount.
- Schedule flights/train tickets well in advance. Scheduling earlier can help reduce costs and secure your spot in a transit. Especially regarding train tickets, some trains can fully book a month in advance.
- Assuming you plan on traveling within your time here, invest in a Eurail Pass. I bought a Eurail Pass gave me 10 days within a two-month period of unlimited train usage for \$324. While this pass may seem expensive, it is worth the costs and grants access to travel across almost all countries within Europe.

- Do not be afraid to make friends. Meeting others in the program, people in your institute, and other people around the city can make your experience more enjoyable. Additionally, meeting people can make it easier getting around Europe.
- Do not be afraid to travel alone. Traveling alone is an experience worth attempting. It can improve one's ability to navigate a foreign country. That being said, travelling with a buddy also has its merits. It can make meeting people easier, and it can make your experience more enjoyable while also safer. Additionally, it can reduce costs of hotels/hostels.
- A fair number of buildings in Germany do not have A/C, including the student dorms. Investing in a fan can go a long way considering it can get hot during the summer.
- Learn to cook! Along with being a great life skill, it can save you money. While not all kitchen appliances are provided, they can be found at nearby stores for a reasonable price.
- Bringing melatonin or other sleeping medicine can help reduce the jetlag effects.
- Before arriving, have a plan for your phone's ability to access cellular data. Some carriers will have unlimited data, but for other carriers, they do not provide in Germany. An alternative is buying a German SIM card.
- Beer! While not everyone likes to drink beer, it is worth at least trying once. The beer in Germany better than almost all beer in the US. Additionally, radlers are a good alternative because they do not have as potent of a beer taste.